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Spatially variable rainfall thresholds for landsliding in Tuscany

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Despite the many recent attempts at devising a general physically-based model to predict the dynamics of rainfall induced landslide in real-time, there remain several drawbacks related to the difficulty in estimating the required parameters which show a high spatial variability. For these reasons approaches based on empirical thresholds of rainfall intensity and duration are still widely used and in many cases represent the only possible solution for an effective early warning. Furthermore, the definition of regional triggering thresholds is of notable interest for the understanding of the spatial relationship linking rainfall to landsliding at global scale.
We present here the results of a very detailed study concerning the territory of the Tuscany region (ab. 23,000 km2, Central Italy) where more than 2100 dated events occurring in the period 2000-2007 were registered and analyzed in terms of rainfall patterns, intensity-duration curves, critical intensity and possible return time with the aim of defining a spatially variable rainfall threshold for civil protection purposes. In fact, the strong variability of environmental, geological and geological factors within the study area, together with evidences from available data on triggering conditions, imply that a single general threshold would be affected by a too large degree of overestimation of hazard and suggest the adoption of locally defined thresholds.
Data from about 330 automated rainfall gauge stations have been used and compared each other during activation times in order to understand and define: i) the spatial correlation structure of rainfall at and within gauge stations; ii) the degree of likelihood of triggering for the intensity-duration curves relative to stations surrounding a landslide location; iii) a set of mathematical functions that fit cumulated rainfall patterns as a framework to spatial interpolation and averaging of intensity-duration relationships ; iv) a tool for the automated extraction of critical intensity values from cumulative rainfall distributions.
The results will then be combined into a standard open procedure with a high degree of automation for the use of civil protection agencies within Tuscany.